ISTEP 2012

ICT Strategic Transmission Expansion Plan

November 30, 2012

SPP Southwest Power Pool

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Executive Summary

The ICT Strategic Transmission Expansion Plan (ISTEP) is an annual study process which assesses Entergy's long-term transmission needs beyond the three-year cost allocation window of Entergy's Construction Plan and the ICT's Base Plan. A primary purpose of this process is to promote extra-high voltage (EHV) transmission expansion by identifying problem areas and developing long-term strategic solutions. The expectation is that such facility upgrades will provide enhanced reliability and economic benefits to Entergy transmission system users.

The ICT seeks to identify projects outside of the scope of the ICT Base Plan which is performed pursuant to Attachment T of Entergy's Open Access Transmission Tariff (OATT). Section 3.2 of Attachment T states:

> The ICT will assess whether a proposed upgrade should be considered a Base Plan Upgrade or Supplemental Upgrade. For purposes of this Section 3.2, the ICT will consider only upgrades in the then-current Base Plan for which construction is to be initiated within the next three years.

Attachment K provides additional guidance in the development of transmission expansion projects. Another duty of the ICT, as outlined in Section 14 of Entergy's Attachment K, is that of identifying potential economic upgrades. Section 14 of Attachment K states:

> The ICT will identify such upgrades based on screening criteria, which may include considerations such as frequent transmission loading relief events, frequently constrained flowgates in the Available Flowgate Capability (AFC) process or the Weekly Procurement Process (WPP), flowgates with high congestion costs as identified in the WPP process, and commonly invoked must-run operating guides.

This annual process began on November 17, 2006 and culminated in the posting of the first ISTEP Report on December 4, 2007. Per Attachment K of Entergy's OATT, the ICT will, prior to each calendar year, seek input from the Transmission Provider and stakeholders before determining which projects, up to a total of five (5), will be included in the proceeding ISTEP study process. The ICT receives input from the Transmission Provider and stakeholders through its participation in working groups such as the Stakeholder Policy Committee (SPC) and the SPP Transmission Working Group (TWG).

A formal request for potential projects to be included in the ISTEP 2012 was made via email on July 11, 2012. Suggested projects were gathered by the ICT and presented to the SPC during subsequent meetings. A list of 29 projects was presented to stakeholders to rank their preference from 1 to 29 on July 19, 2012. The top 10 projects list was nominated by stakeholders. The list of nominated projects was presented to stakeholders on July 26, 2012 and stakeholders were given five votes each to use for their selection of the projects to be included in the 2012 study. The five projects chosen for the ISTEP 2012 process were selected based on stakeholder voting and presented to the stakeholders thru email on August 2, 2012. The five projects are below:

ISTEP 2012 Projects
New Hartburg – Sabine 230 kV Line
Dell – San Souci 500 kV ftlo West Memphis – Keo 500 kV Line
Amite South Area
New 500/345 kV Station at Messick & Dolet Hills – Messick 345 kV Line
Franklin – Bogalusa 500 kV Contingency

Selected Projects for ISTEP 2012

The New Hartburg to Sabine 230 kV line was selected as a study to mitigate congestion created by the Hartburg to Cypress 500 kV contingency on the underlying 230 kV system and the Nelson 500/230 kV auto transformer. The Hartburg to Cypress contingency is one of the top transmission constraints in terms of limiting AFC's, long-term transmission service, and TLR's. The Hartburg to Cypress 500 kV contingency was previously studied in ISTEP 2010.

The Dell to San Souci 500 kV line for the loss of the West Memphis to Keo 500 kV line was selected to evaluate possible congestion relief solutions in the area.

The Amite South Area project was selected by stakeholders as a regional study to evaluate projects to increase transfer capability into the region (Baton Rouge and New Orleans area). Amite area issues were previously studied in ISTEP 2007.

The New 500/345 kV station at Messick and the Dolet Hills to Messick 345 kV line was selected by stakeholders as a possible solution to increase the East and West transfer capability in the area between Entergy and SPP. Messick issues were previously studied in ESRPP 2009 and 2010.

The Franklin to Bogalusa 500 kV contingency was selected by stakeholders because this contingency limits North to South transfers on the East side of the Entergy system due to the 138 kV and 115 kV network limits.

Section 1: Background Information

The following ten (10) projects were proposed for evaluation in ISTEP 2012 with each consisting of one or more transmission system upgrades.

Proposed Projects
New Hartburg – Sabine 230 kV Line
North Louisiana Area: Sterlington, El Dorado, Magnolia
Dell – San Souci 500kV ftlo West Memphis-Keo 500 kV Line
Amite South Area: Baton Rouge, New Orleans, LUS
West Louisiana/East Texas Area: Beaumont, Richard, Weber
New 500/345 kV Station at Messick & Dolet Hills - Messick 345 kV Line
Franklin - Bogalusa 500 kV Contingency
Nelson Auto 500/230 kV ftlo Hartburg - Cypress 500 kV Line
Fairview - Gypsy 230 kV: Fairview - Madisonville 230 kV
Nelson - Sabine 230 kV

Table 1.1: Proposed Projects

The projects listed above were focused on creating new, higher-voltage transmission in order to address system expansion and performance needs on Entergy's transmission system, as opposed to upgrading the underlying voltage systems.

Subsequent to the publication of the ISTEP 2011 report, the ICT requested the stakeholders provide a priority ranking for the ISTEP 2012 projects. Based on the stakeholders' voting, a final ranking was developed.

The top five (5) projects chosen for further study in the ISTEP 2012 are as follows:

ISTEP 2012 Projects
New Hartburg – Sabine 230 kV Line
Dell – San Souci 500 kV ftlo West Memphis – Keo 500 kV Line
Amite South Area
New 500/345 kV Station at Messick & Dolet Hills – Messick 345 kV Line
Franklin – Bogalusa 500 kV Contingency

Table 1.2: Selected Projects

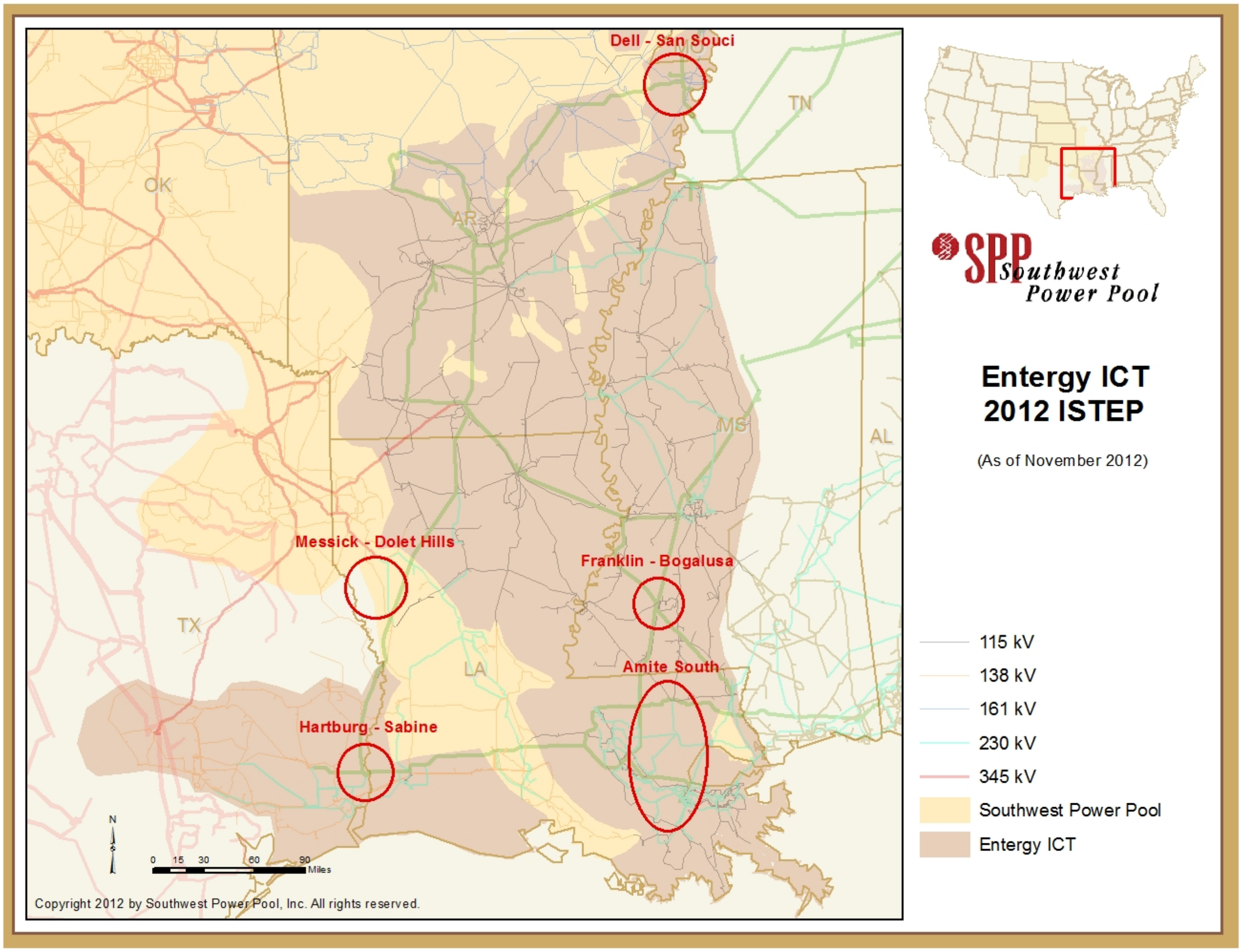


Figure 1.1: 2012 ISTEP Project Locations

Section 2: Objectives

The ISTEP 2012 was created with several key objectives driving the projects that compose the Plan. Those objectives were: improving load-serving capability, improving transfer capability, improving deliverability to load pockets/load centers, and relieving constraining flowgates. Meeting these objectives should result in a more robust transmission system capable of providing both reliable service and economic delivery of power across the regional transmission system. Each objective is discussed in further detail below.

2.1 Improving Load-Serving Capability

The ISTEP 2012 projects are designed to enhance the regional transmission system by improving its ability to serve load. The upgrades accomplish this task by providing increased voltage support, increased thermal capacity, and additional transfer paths from the generation to the load.

2.2 Improving Inter-Regional Transfer Capability

The Entergy transmission system interfaces with 19 control areas; including both SERC and SPP members. The ISTEP 2012 includes projects that improve the ability to move power from and into the Entergy region.

2.3 Improving Deliverability to Load Pockets/Load Centers

The Entergy transmission system has several recognized load pockets. Those are areas of high load, with limited local generation, and are dependent upon transmission lines in order to move power into the area. One focus of ISTEP 2012 is to increase the import capability into these load pockets.

2.4 Relieving Constraining Flowgates

Under certain system conditions, flowgates can become constrained during real-time operations. When this occurs, the ICT will institute congestion management procedures, often in the form of Transmission Loading Relief (TLR). TLR procedures have a number of levels and can result in the curtailment of non-firm and/or firm transmission service. In addition to the operational issues, there are a number of flowgates that frequently constrain the sale of transmission service. The ISTEP 2012 includes upgrades that are intended to address some of the current most constraining flowgates from both a TLR and a transmission service perspective.

Section 3: Models and Assumptions

3.1 Engineering Models Assumptions

The 2018 summer model from the Entergy's long term planning models was used as the starting point for the ISTEP 2012 study process. The 2018 model was created from Entergy and SPP models by combining Entergy and SPP topology, generation, and transactions. Several additional dispatch scenarios were modeled in order to simulate system conditions that could cause a flowgate to overload under a contingency. The approved projects from the 2012-2016 Entergy Final Construction Plan Update 2 were added to the 2018 summer model to obtain the ISTEP 2012 base case powerflow model. See Appendix A for a list of Approved Construction Plan Projects.

3.2 Economic Assessment Models Assumptions

Economic modeling, simulations, and results were performed using GridView. In general, GridView is a database driven software package that uses a linear programming approach for economic simulation of electric power systems. Its application is for generation and transmission expansion planning, market simulation, and production cost modeling. GridView uses a Security Constrained Unit Commitment (SCUC) and Security Constrained Economic Dispatch (SCED) to simulate the most economic generation dispatch while observing system security constraints. Significant effort was required in gathering detailed data and ensuring that correct information was used as input data for the simulation software.

3.3 Input Power Flow Case

As previously mentioned, all approved projects from the Entergy 2012-2016 Final Construction Plan Update 2 were added to the 2018 summer power flow model. The resulting power flow model raw data was used as one input for the economic simulations.

Load Area Definitions

The GridView model areas are defined as follows:

Entergy		
1	Entergy Arkansas	
2	Entergy Mississippi	
3	Entergy Louisiana South	
4	Entergy Louisiana North	
5	Entergy NOPSI	
6	Entergy Gulf States	
7	Entergy Texas	
Entities Operating within Entergy Footprint		
1	LAGN	(Louisiana Generating)
2	WMUC	(City of West Memphis, AR)
3	CONWY	(City of Conway, AR)
4	BUBA	(City of Benton, AR)
5	PUPP	(Union Power Partners Generating Station)
6	DERS	(City of Ruston, LA)
7	DENL	(City of North Little Rock, AR)
8	CELE	(Central Louisiana Electric Company (CLECO))
9	LAFA	(City of Lafayette, LA)
10	LEPA	(Louisiana Energy and Power Authority)
11	SWPA	(Southwestern Power Administration)
12	PLUM	(Plum Point Generation)
Entergy Tier 1		
1	SOCO	(Southern Company)
2	TVA	(Tennessee Valley Authority)
3	SMEPA	(South Mississippi Electric Power Association)
4	AECC	(Arkansas Electric Cooperatives Corporation)
5	AMMO	(Ameren Missouri Utility)
6	AECI	(Associated Electric Cooperative, Inc)
7	BCA	(Batesville Generating Station)
8	SPP	(Southwest Power Pool)

Table 3.1: GridView Model Areas

Other Inputs and Assumptions

Other system characteristics and assumptions used as inputs are as follows:

- **Generators**
  - Generation RMR operating guides were included in the model.
  - Hydro units were modeled based on historic output levels.
- **Transmission**
  - Selected flowgates and interfaces were monitored.
- **Loads**
  - 8,760 hourly load profiles were used for all areas.
  - 2018 forecasts were collected from FERC filings, SPP EIA-411, and Entergy.
  - Non-conforming loads in Entergy load serving areas were defined and modeled as fixed loads.
- **Emissions**

  Emission rates for NO_x, SO_2, and CO_2, were collected from EPA sources, and modeled in the production cost model. Rates are listed below in Table 3.2.

2018 Emission Rates ($/Short Ton)		
CO_2	NO_x	SO_2
0	1,740	369

Table 3.2: 2018 Emission Rates

- **Wheeling Charge**

  Wheeling charges are "per MWh" charges for moving energy from one area to another. GridView models this charge as a tariff for a particular interface. Commitment and dispatch are the two types of charges that can be assessed in GridView. A commitment charge is only applied to the initial startup of a unit and a dispatch charge is applied per MWh of an operating unit. The wheeling charge used were the same used in the Minimizing Bulk Power Costs Study (MBPC)

Market Assumption	From	To	Wheeling Charge ($/MWh)	
			Commitment	Dispatch
Entergy is not in SPP Market	Cleco	SPP, Entergy, LEPA and LAFA	10	6
	Cleco	LaGen	10	3
	Entergy	LaGen	10	3
	Entergy	Cleco, SPP, AECI, LEPA, LAFA, SMEPA	10	6
	Entergy	All Other	1,000	8
	SPP	Cleco, Entergy, AECI, LEPA, LAFA, LaGen	10	5
	SPP	All Other	1,000	5
	LEPA	Entergy and Cleco	10	6
	LAFA	Entergy and Cleco	10	6
	LaGen	Entergy and Cleco	10	3
	LaGen	SOCO	1,000	8
	Entergy IPPs w/o LTC	Entergy	5	0
	AECI and SMEPA	SPP and Entergy	10	6
	AECI and SMEPA	All Other	1,000	8

Table 3.3: Wheeling Charges

- **Fuel Prices**

  The fuel costs used were the same used in the Minimizing Bulk Power Costs Study (MBPC). A reference table is located in Appendix B.

Output

The simulation provided output data such as production costs, production profit, load payment, bus Location Marginal Pricing (LMP), and congestion costs. Primary output of interest for this study was the congestion costs. Congestion occurs when a transmission element's thermal limit is exceeded, forcing redispatch of system generation to maintain the limit. The congestion cost is the cost of redispatch of more expensive generation. More precisely, the congestion cost for a transmission line is defined as:

Shadow price ($/MW) is defined as the production cost savings should the thermal limit of the element be raised 1 MW. It should be noted that congestion costs are only incurred during any hour where the MW power flow reaches the constraint limit. If the MW flow is less than the limit, there is no congestion or congestion cost.

3.4 Metrics

There were various metrics used in this report to evaluate robustness and capture additional value added by transmission projects. The following metrics were decided upon by the ICT.

- **Congestion Cost Savings**

  This metric compares Entergy's congestion cost with and without transmission solutions. The metric evaluates how well a transmission solution reduces congestion not only on the element that is being studied, but the entire Entergy system.

- **Change in Adjusted Production Cost**

  Adjusted Production Cost (APC) is a measure of the impact on production cost savings by using LMPs, accounting for purchases and sales of energy between each area. This metric compares adjusted production cost with and without transmission solutions. A negative value means that a reduction in transmission congestion decreased generation production cost. In theory, production cost will decrease when constraints are removed from the system.

- **Levelization of LMPs**

  This metric provides a qualitative indicator of the impact alternative transmission topology could make on a generator's ability to compete on equal grounds. In the absence of congestion and losses in the system, any generator has the potential to serve any load and there will be one single system price in each hour. A transmission system with no constraints and low losses makes the electricity market more competitive, as it provides an equal opportunity to all generators with similar costs to compete for loads. An increase in congestion and losses places generators at certain locations at a disadvantage relative to other similar-cost generators, making the market less competitive. This metric measured the levelization of LMPs for each transmission topology using the standard deviation of LMPs across locations for the Entergy footprint. All else being equal, a decrease in the value of this metric indicates an improvement in the competitiveness of the Entergy transmission system.

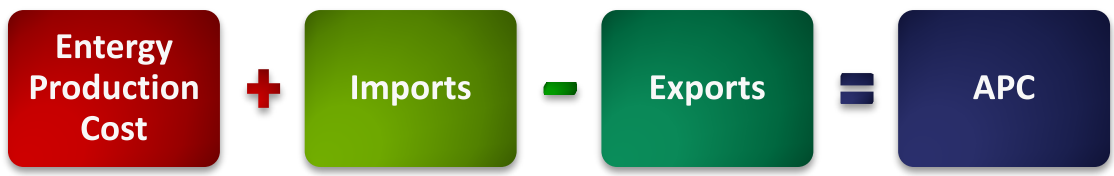
- **Adjusted Production Cost-based Benefit-to-Cost Ratio**

  APC-based B/C refers to the reduction in APC due to a project divided by the carrying charge rate of the planning cost estimate of the project. The ideal APC-based B/C ratio would be greater than 1. A B/C ratio of 1 or greater would imply that the reduction in APC would be equal to or greater than the annual transmission revenue requirement for the upgrade.

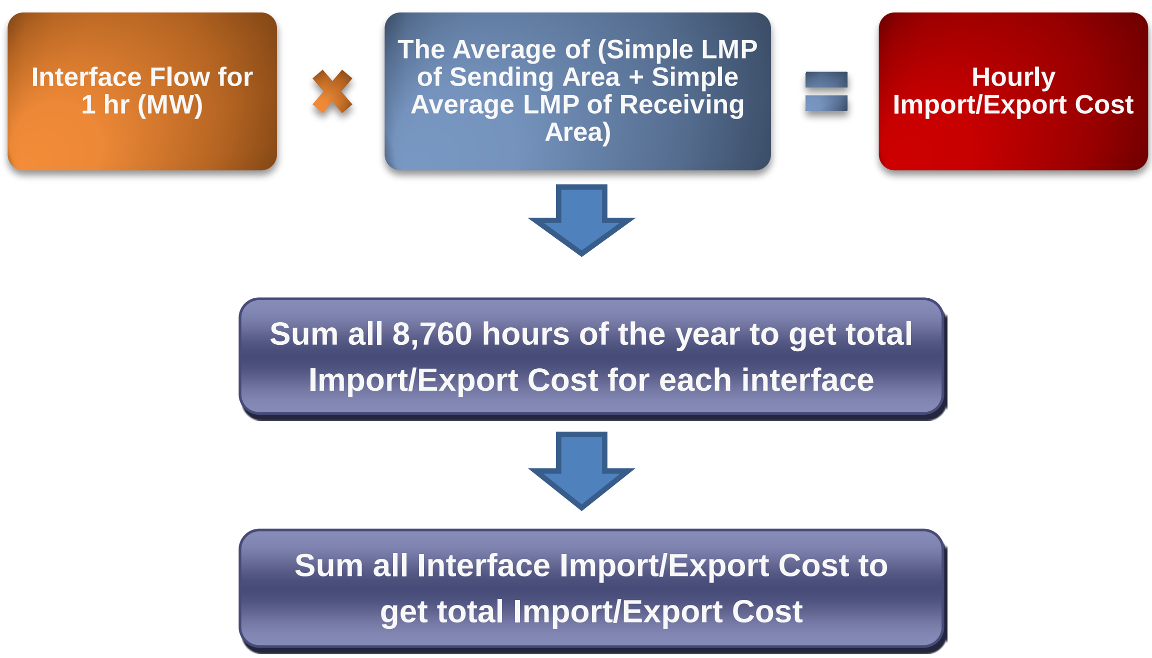
Section 4: Metric Calculation

4.1 Adjusted Production Cost (APC) Calculation

Adjusted Production Cost (APC) is a measure of the impact on production cost savings by using LMPs, accounting for purchases and sales of energy between each area. The APC is calculated by:



4.2 Import/Export Cost Calculation



4.3 APC-Based Benefit-to-Cost-Ratio

*Annualized Transmission Cost is calculated using a 17.5 % Carrying Charge.

Section 5: Study Results

The selected projects were studied using engineering and economic analyses. The engineering analysis consisted of several different steps. The first step was to determine the reason(s) behind the overload or voltage issues. The second step was to determine how to recreate the overload(s) using powerflow modeling. The third step was to develop a solution for the overloads. The final step was to evaluate and test the solution. Once the engineering analysis was completed, the economic analysis was conducted. The economic analysis involved studying the proposed projects in GridView. GridView performed an entire year (8,760 hours) of simulation on the projects and metrics were calculated to evaluate the projects.

5.1 New Hartburg – Sabine 230 kV Line

Engineering Analysis

This analysis focused on mitigating congestion created by the Hartburg to Cypress 500 kV contingency with the focus on the underlying 230 kV system along with the Nelson 500/230 kV auto transformer. The overload issues are with the 500/230 kV Nelson auto transformer, the Hartburg to Inland Orange 230 kV line, and with a few underlying 230 kV lines reaching overload status. A new Hartburg to Sabine 230 kV line should alleviate these issues.

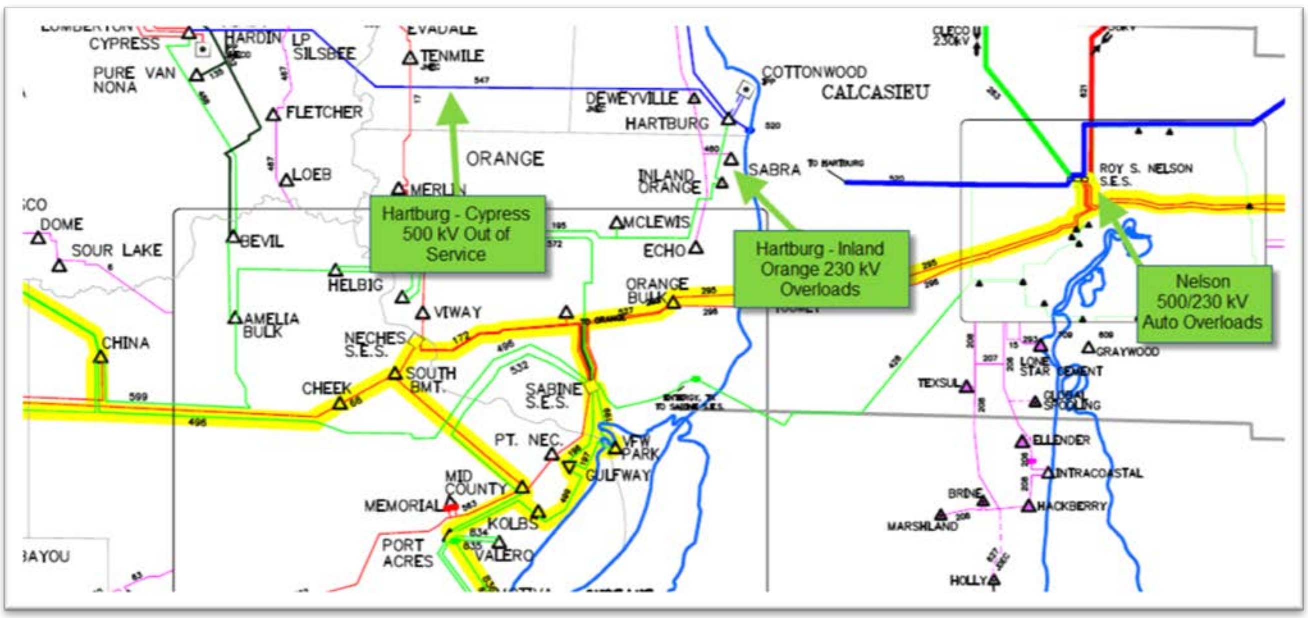


Figure 5.1: Hartburg to Cypress Contingency

Map Reference	Description	Non-Firm Curtailment (MWh)	Firm Curtailment (MWh)
1	Nelson 500/230 kV FTLO Hartburg-Cypress 500 kV Line	14,442	40,327

Table 5.1: 2011 Flowgate Curtailments

Map Reference	Description	Non-Firm Events*	Firm Events*
1	Nelson 500/230 kV FTLO Hartburg-Cypress 500 kV Line	878	32,863

*Non-Firm and Firm Events are from 2011.

Table 5.2: Flowgate-limiting Events

The system conditions were evaluated under the Hartburg to Cypress 500 kV contingency. After some initial review of overloads and possible solutions in the area, it was determined that building a new Hartburg to Sabine 230 kV line alleviated all the overloads. After the solution was applied to the model, a full N-1 contingency scan of the area was conducted and no other projects were needed.

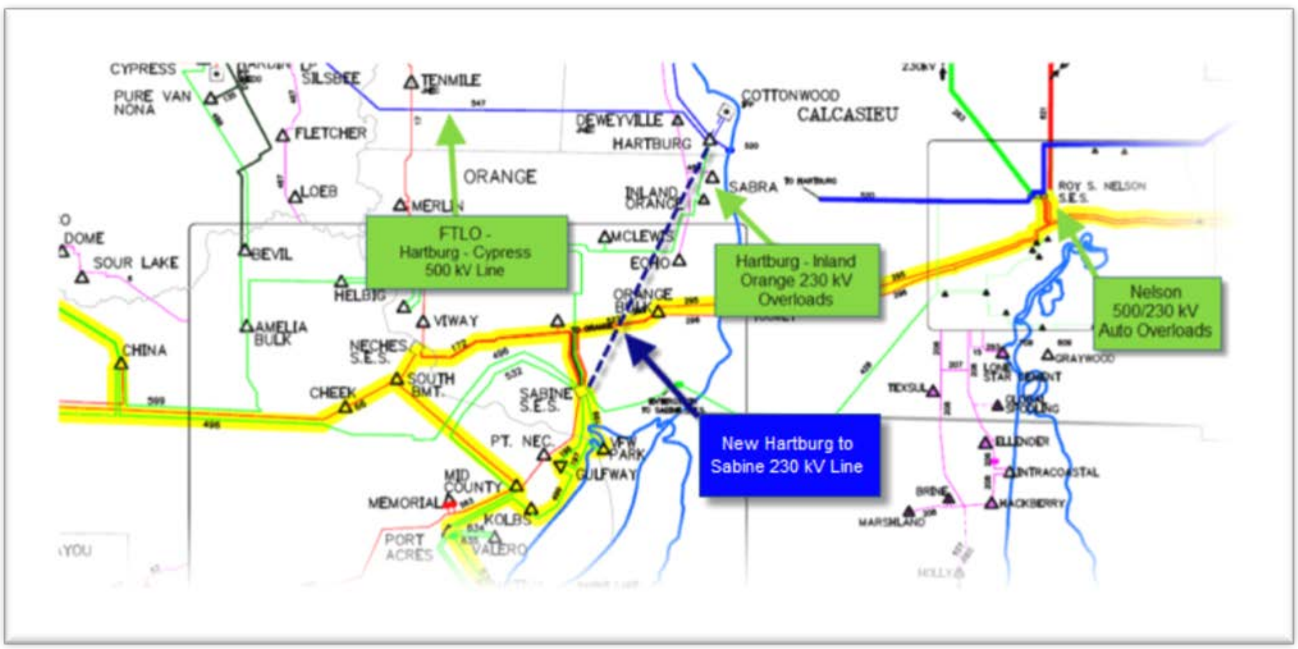


Figure 5.2: New Hartburg to Sabine 230 kV Projects

Description	Line Rating (MVA)	Upgrade Description	ICT Cost Estimate
New Hartburg to Sabine 230 kV Line	566	Build new Hartburg to Sabine 230 kV Line – 25.91 miles	$52.8M
		Total Cost:	**$52.8M**

Table 5.3: Hartburg to Sabine 230 kV Project Costs

Economic Analysis

Subsequent to the powerflow analysis, an economic assessment was performed to determine the selected upgrades. The selected upgrades listed in Table 5.3 have an estimated cost of $52.8 million.

- **Transmission Congestion**

  The following system congestion cost and flowgate loadings were monitored during the SCUC and SCED. The resulting congestion cost and congestion hours for 2018 are shown in Table 5.4 below for the Hartburg to Cypress flowgate.

	Base Case		Change Case			
			Change in Congestion Cost		Change in Congestion Hours	
Contingency	Congestion Cost ($K)	Congestion Hours	$K	%	Hours	%
Hartburg – Cypress 500 kV Line	21,831	1,023	12,756	58.4	610	59.6
EES	636,848	27,011	(15,409)	(2.42)	(177)	(0.66)

Table 5.4: 2018 Congestion Cost and Congestion Hours

- **Production Cost Results and Benefits**

  The projects were applied to the GridView model and a full year simulation (8,760 hrs) was performed on the 2018 model to analyze the Entergy generation changes. The table below shows production cost changes for the Entergy units.

	Change in Adjusted Production Cost
Entergy	$13M

Table 5.5: 2018 Hartburg – Sabine 230 kV Project Adjusted Production Cost Changes

- **LMP Levelization**

  ICT calculated the levelization of LMPs using output from GridView, which reported both load-weighted and generation-weighted LMP values for each hour of the year for the Entergy Texas region. ICT then calculated the standard deviation of the load-weighted and generation-weighted LMPs for each hour of the studied year. Using the largest 25% of all hours, the average load-weighted and generation-weighted standard deviations were calculated.

	Std. Dev. Δ ($)
Hartburg – Sabine 230 kV	(0.27)

Table 5.6: Combined average Load-Weighted and Generation-Weighted Standard Deviation

5.2 Dell-San Souci 500 kV ftlo West Memphis-Keo 500 kV Line

Engineering Analysis

This analysis focused on mitigating congestion created by the West Memphis to Keo 500 kV line contingency with the focus on the underlying 161 kV system. The overload issues were created by the following events: West Memphis to Keo 500 kV out of service and weather related issues caused a forced outage of the ISES to Keo 500 kV line. With this forced outage, several underlying 161 kV lines were impacted in the area. A new 40 mile Newport to Wynne South 161 kV line should alleviate these issues.

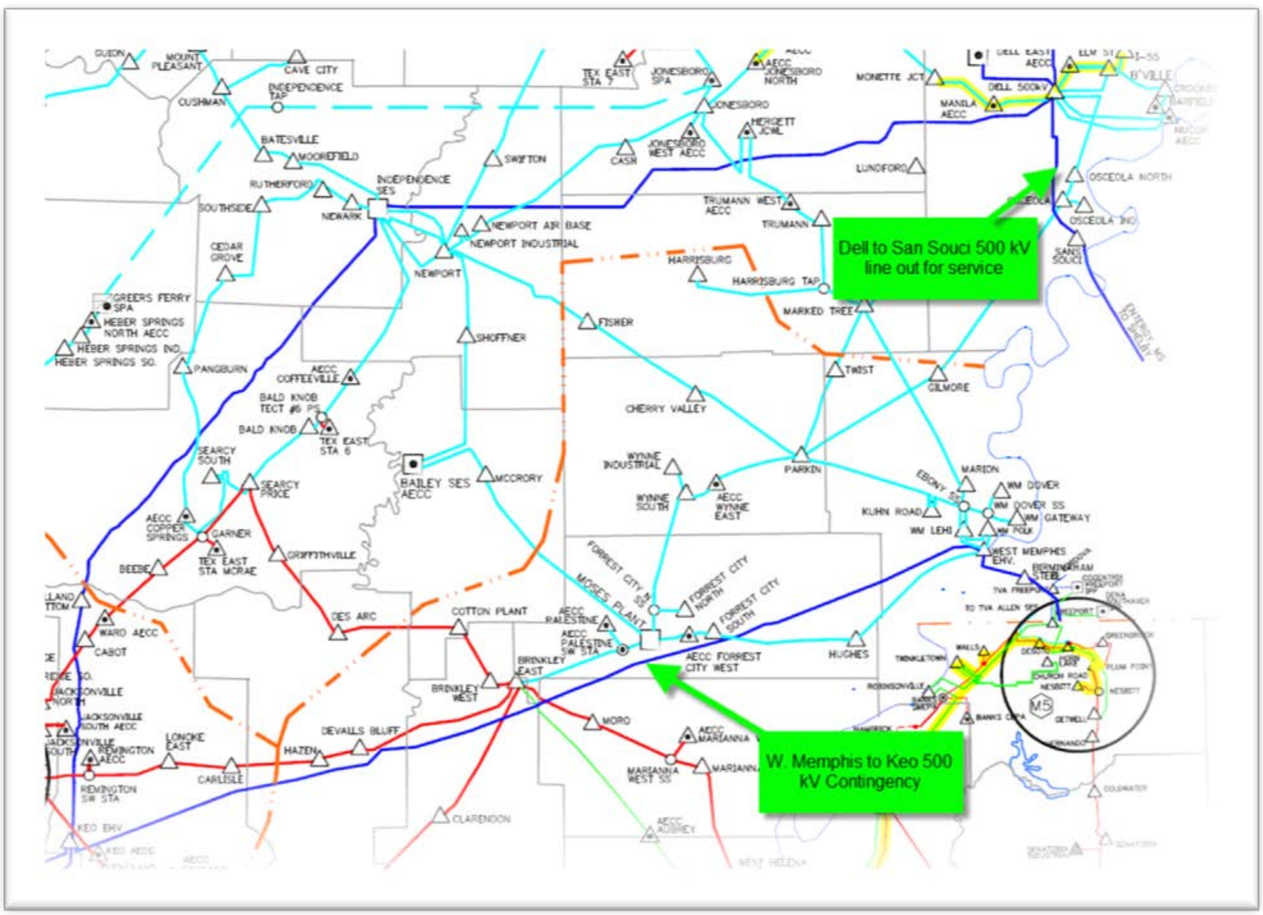


Figure 5.3: Dell – San Souci 500 kV ftlo W. Memphis – Keo 500 kV Line

Map Reference	Description	Non-Firm Curtailment (MWh)	Firm Curtailment (MWh)
1	Dell – San Souci	44,771	52,364

Table 5.7: 2011 Flowgate Curtailments

Map Reference	Description	Non-Firm Events*	Firm Events
1	Dell – San Souci	0	0

*Non-Firm and Firm Events are from 2011.

Table 5.8: Flowgate-limiting Events

The system conditions were evaluated under the West Memphis to Keo 500 kV contingency. After some initial review of overloads and possible solutions in the area, it was determined a new Newport to Wynne South 161 kV line would alleviate all the overloads. After the solution was applied to the model, a full N-1 contingency scan of the area was conducted and no other projects were needed.

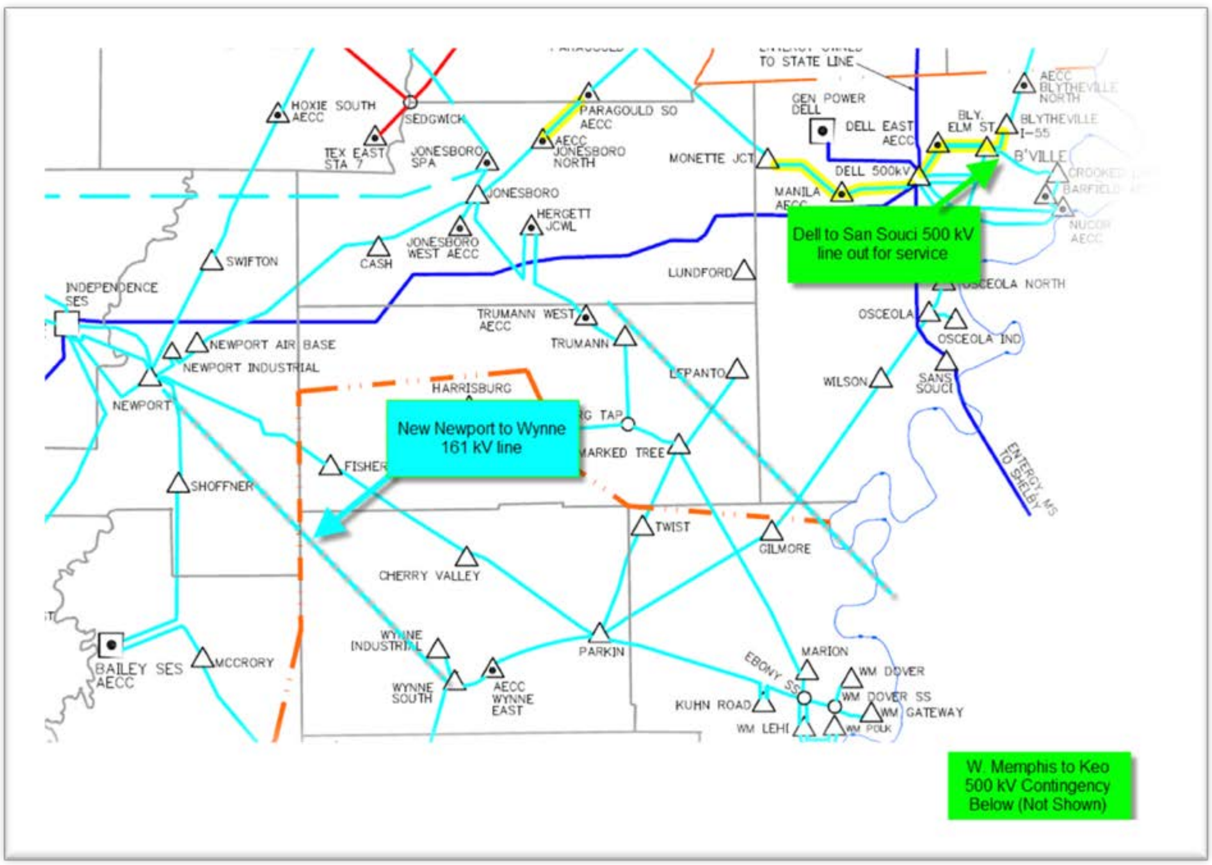


Figure 5.4: Dell – San Souci 500 kV Line ftlo W. Memphis - Keo 500 kV Line

A detailed description of the solution set upgrades is shown below:

Description	Line Rating (MVA)	Upgrade Description	ICT Cost Estimate
New 161 kV line from Newport-Wynne South	246	New 161 kV line from Newport – Wynne South (40 miles)	$81.56M
		Total Cost:	**$81.56M**

Table 5.9: Dell – San Souci Project Cost

Economic Analysis

Subsequent to the powerflow analysis, an economic assessment was performed to determine the selected upgrades. The selected upgrades listed above have an estimated cost of $81.56 million.

- **Transmission Congestion**

  The following system congestion costs and flowgate loadings were monitored during the SCUC and SCED. The resulting congestion cost and congestion hours for 2018 are shown in Table 5.10 below for Entergy and the identified contingencies.

	Base Case		Change Case			
			Change in Congestion Cost		Change in Congestion Hours	
Contingency	Congestion Cost ($K)	Congestion Hours	$K	%	Hours	%
Dell-San Souci 500 kV ftlo W. Memphis-Keo 500 kV Line	0	0	0	0	0	0
EES	636,848	27,011	(3,562)	(.56)	(97)	(.36)

Table 5.10: 2018 Congestion Cost and Congestion Hours

- **Production Cost Results and Benefits**

  The project was applied to the GridView model and a full year simulation (8,760 hrs) was performed on the 2018 model to analyze the Entergy generation changes. The table below shows production cost changes for the Entergy units.

	Change in Adjusted Production Cost
Entergy	$2M

Table 5.11: 2018 Dell – San Souci Project Adjusted Production Cost Changes

- **LMP Levelization**

  ICT calculated the levelization of LMPs using output from GridView, which reported both load-weighted and generation-weighted LMP values for each hour of the year for the Entergy Arkansas region. ICT then calculated the standard deviation of the load-weighted and generation-weighted LMPs for each hour of the studied year. Using the largest 25% of all hours, the average load-weighted and generation-weighted standard deviations were calculated.

	Std. Dev. Δ ($)
Upgrade Dell – San Souci 500 kV Area	(0.04)

Table 5.12: Combined average Load-Weighted and Generation-Weighted Standard Deviation

5.3 Amite South

Engineering Analysis

This analysis focused on the reliability affecting the underlying 230 kV network in the Amite South area of Louisiana. The area was evaluated to determine if any contingency found in the Amite South area causes any issue. In comparing contingencies from a 2011 model to a 2018 model, no existing issues appear in the 2018 model. Several projects that Entergy has in its Construction Plan address current issues in this area. ICT performed a 2,000 MW transfer from SPP South to Entergy Louisiana for the Amite South area. Construction of a new PPG 230/69 kV auto transformer, a rebuild of the PPG to Verdine 230 kV line, a rebuild of the Big Cajun to Addis 230 kV line, and a rebuild of the Rose Bluff to PPG 230 kV line will alleviate the transfer issues. Table 5.13 lists the flowgate curtailments for 2011. Table 5.14 lists the number of events where the flowgate limited a Firm or Non-Firm AFC request.

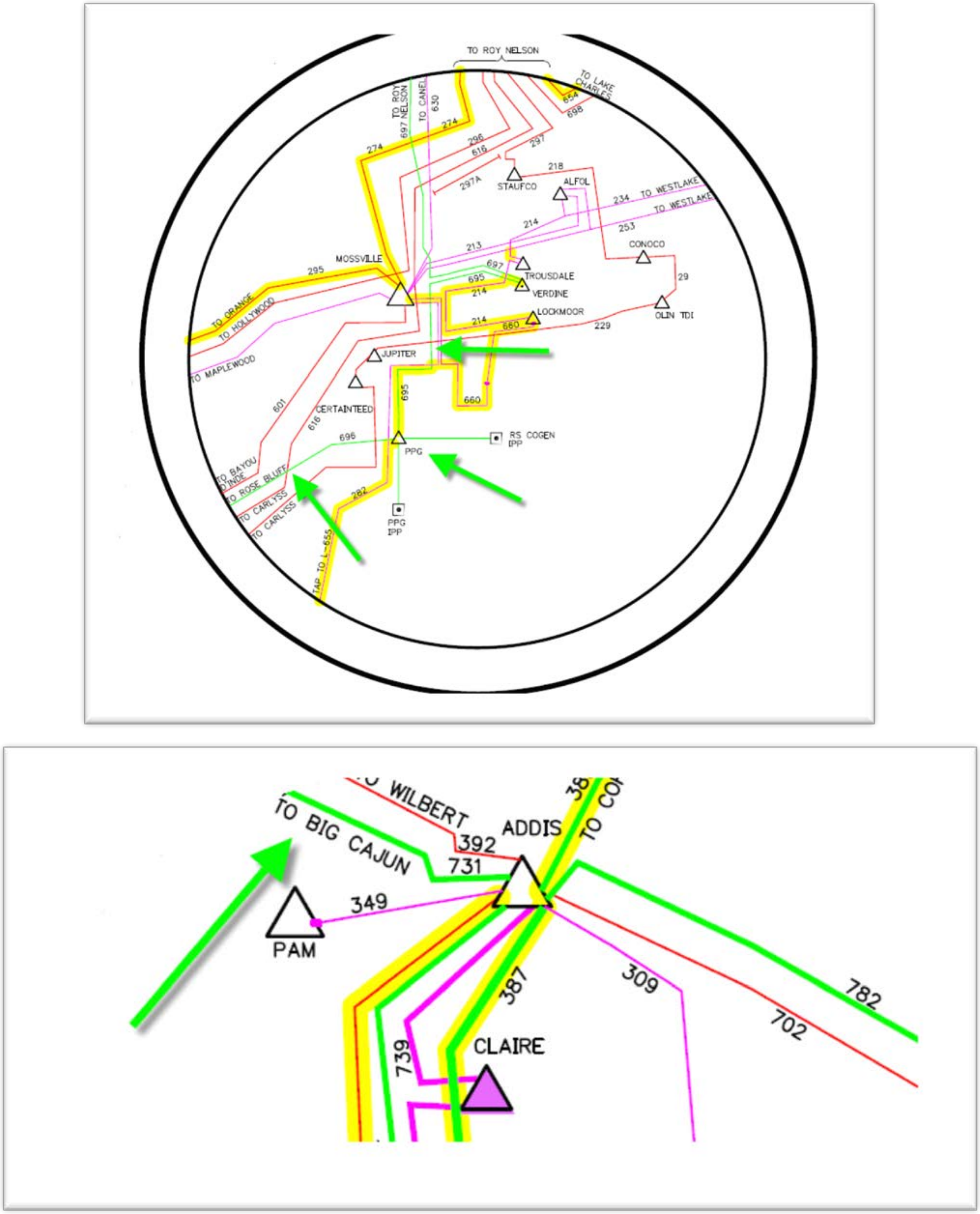


Figure 5.5: Amite South Area

Map Reference	Description	Non-Firm Curtailment (MWh)	Firm Curtailment (MWh)
1	Amite South Area	0	0

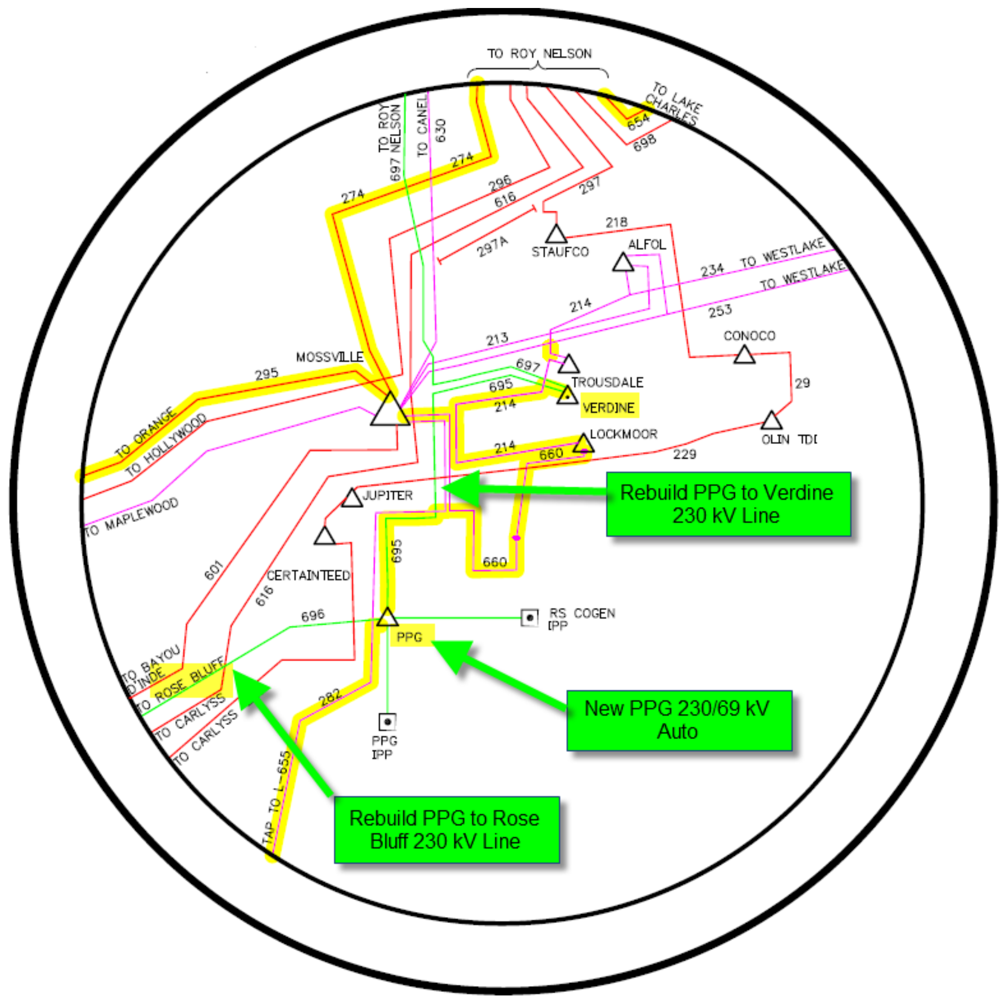
Table 5.13: 2011 Flowgate Curtailments

Map Reference	Description	Non-Firm Events*	Firm Events*
1	Amite South Area	0	0

*Non-Firm and Firm Events are from 2011.

Table 5.14: Flowgate-limiting Events

The system conditions were evaluated under the Amite South area, focusing on the reliability of the underlying 230 kV network. After some initial review of the area and performing a transfer analysis, it was determined that constructing a new PPG 230/69 kV auto transformer, rebuilding the PPG to Verdine 230 kV line, rebuilding the Big Cajun to Addis 230 kV line, and rebuilding the Rose Bluff to PPG 230 kV line will alleviate the transfer issues.



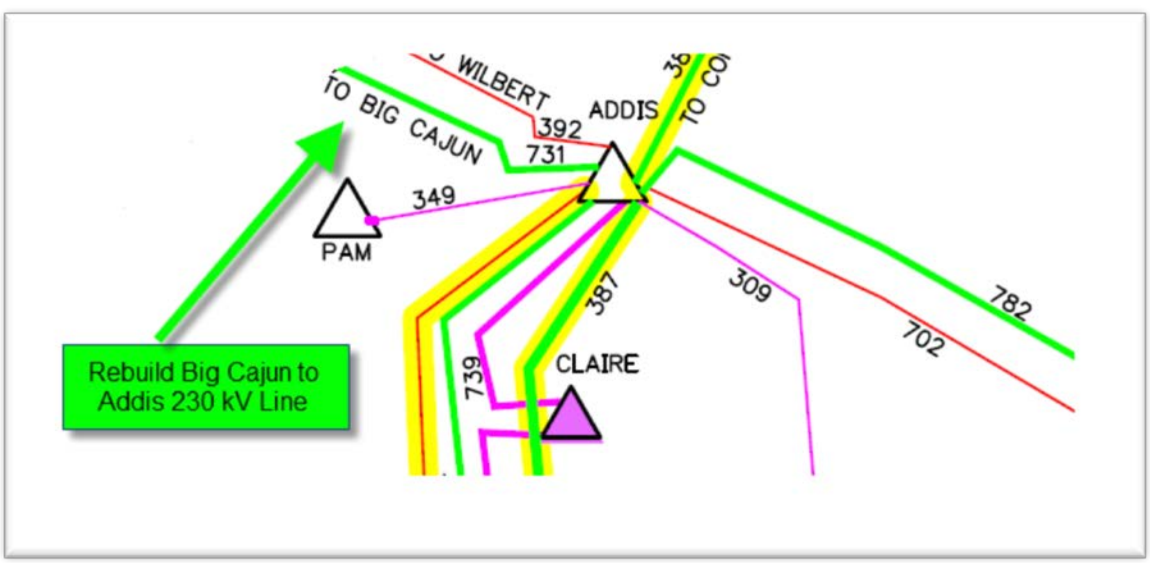


Figure 5.6: Amite South Projects

A detailed description of the solution set upgrades is shown below:

Description	Line Rating (MVA)	Upgrade Description	ICT Cost Estimate
PPG – Verdine 230 kV line	685	Rebuild PPG – Verdine 230 kV line (2.27 miles)	$3.7M
PPG 230 kV Station	300	New PPG 230/69 auto transformer	$6.2M
PPG – Rose Bluff 230 kV line	797	Rebuild PPG – Rose Bluff 230 kV line (4.83 miles)	$6.7M
Big Cajun - Addis 230 kV line	1039	Rebuild Big Cajun – Addis 230 kV line (24.9 miles)	$34.5M
		Total Cost:	**$51.1M**

Table 5.15: Amite South Project Upgrade Costs

Economic Analysis

Subsequent to the powerflow analysis, an economic assessment was performed to determine the selected upgrades. The selected upgrades listed in Table 5.3 have an estimated cost of $51.1 million.

- **Transmission Congestion**

  The following system congestion cost and flowgate loadings were monitored during the SCUC and SCED. The resulting congestion cost and congestion hours for 2018 are shown in Table 5.16 below for the Amite South area flowgate.

	Base Case		Change Case			
			Change in Congestion Cost		Change in Congestion Hours	
Contingency	Congestion Cost ($K)	Congestion Hours	$K	%	Hours	%
Amite South Area	0	0	(167,121)	0	(4818)	0
EES	636,848	27,011	259	.04	9	.03

Table 5.16: 2018 Congestion Cost and Congestion Hours

- **Production Cost Results and Benefits**

  The projects were applied to the GridView model and a full year simulation (8,760 hrs) was performed on the 2018 model to analyze the Entergy generation changes. The table below shows production cost changes for the Entergy units.

	Change in Adjusted Production Cost
Entergy	$0M

Table 5.17: 2018 Amite South 230 kV Project Adjusted Production Cost Changes

- **LMP Levelization**

  ICT calculated the levelization of LMPs using output from GridView, which reported both load-weighted and generation-weighted LMP values for each hour of the year for the Entergy Louisiana region. ICT then calculated the standard deviation of the load-weighted and generation-weighted LMPs for each hour of the studied year. Using the largest 25% of all hours, the average load-weighted and generation-weighted standard deviations were calculated.

	Std. Dev. Δ ($)
Amite South Area	0.001

Table 5.18: Combined average Load-Weighted and Generation-Weighted Standard Deviation

5.4 New 500/345 kV Station at Messick and New Messick to Dolet Hills 345 kV Line

Engineering Analysis

This analysis focused on providing support for east to west transfers between Entergy and SPP. The area around Messick and Dolet Hills was evaluated under multiple scenarios created to bias the system and create a transfer that would overload the system. After initial review of overloads and possible solutions in the area, it was determined the construction of a new 500/345 kV substation at Messick and a new 345 kV transmission line between Messisk to Dolet Hills will improve the east to west transfers as seen from the First Contingency Incremental Transfer Capability (FCITC) results in Table 5.21 below.

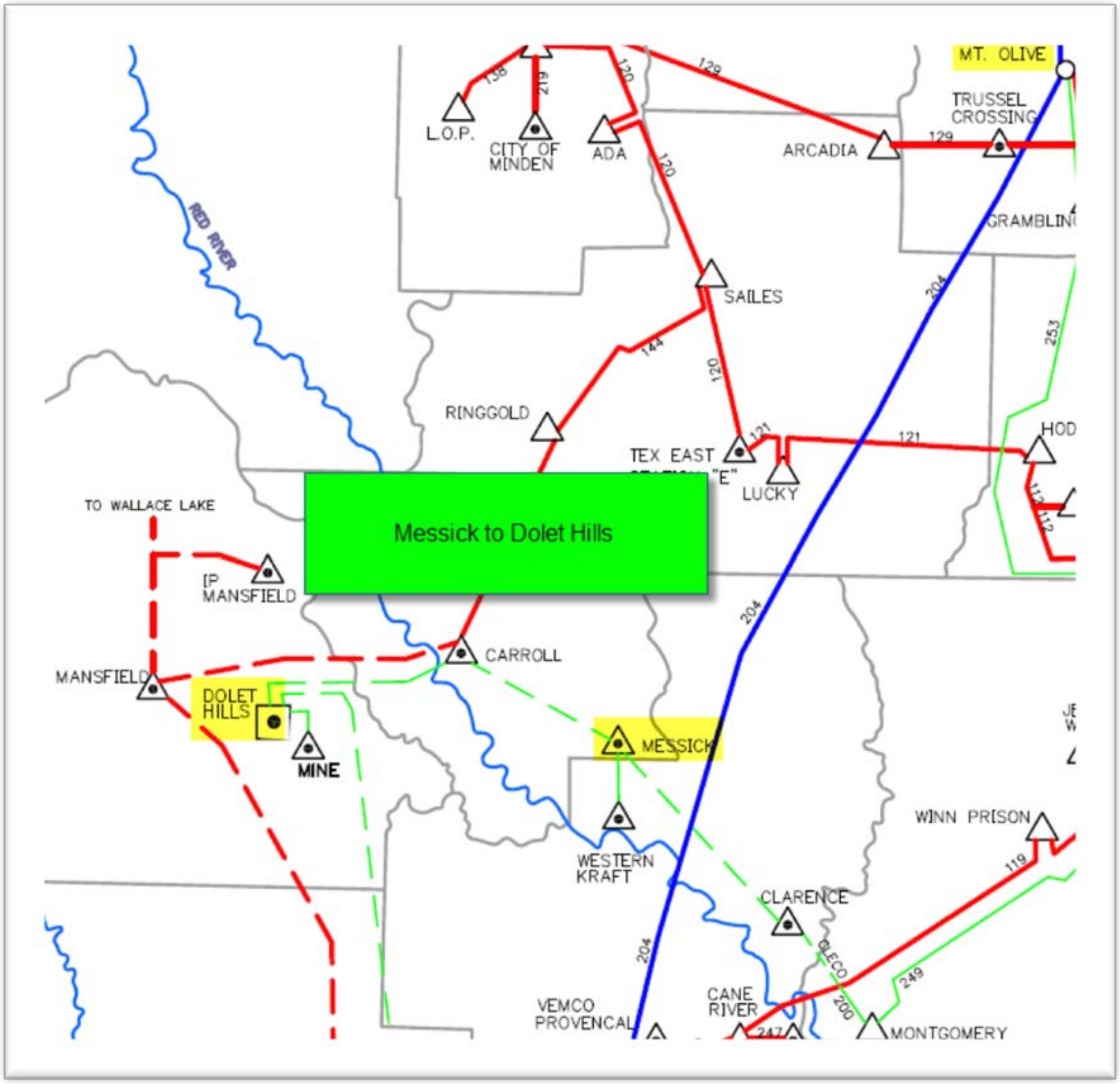


Figure 5.7: Messick to Dolet Hills Area

Map Reference	Description	Non-Firm Curtailment (MWh)	Firm Curtailment (MWh)
1	Messick to Dolet Hills Area	N/A	N/A

Table 5.19: 2011 Flowgate Curtailments

Map Reference	Description	Non-Firm Events	Firm Events
1	Messick to Dolet Hills Area	N/A	N/A

*Non-Firm and Firm Events are from 2011.

Table 5.20: 2011 Flowgate-limiting Events

System conditions were evaluated for the Amite South area with a focus on the issues affecting reliability in the northwest and central west areas of Louisiana; mainly around the Messick area. The area was evaluated to support an east to west transfer between Entergy and SPP. After some initial review of the overloads and possible solutions in the area, it was determined that building a new 345 kV line from Messick to Dolet Hills will alleviate the constraints. Work to be considered was a new 500/345 kV auto transformer at Messick, constructing a new Messick to Dolet Hills 345 kV line, and tapping the Hartburg to Mt. Zion 500 kV line with the Messick 500 kV line.

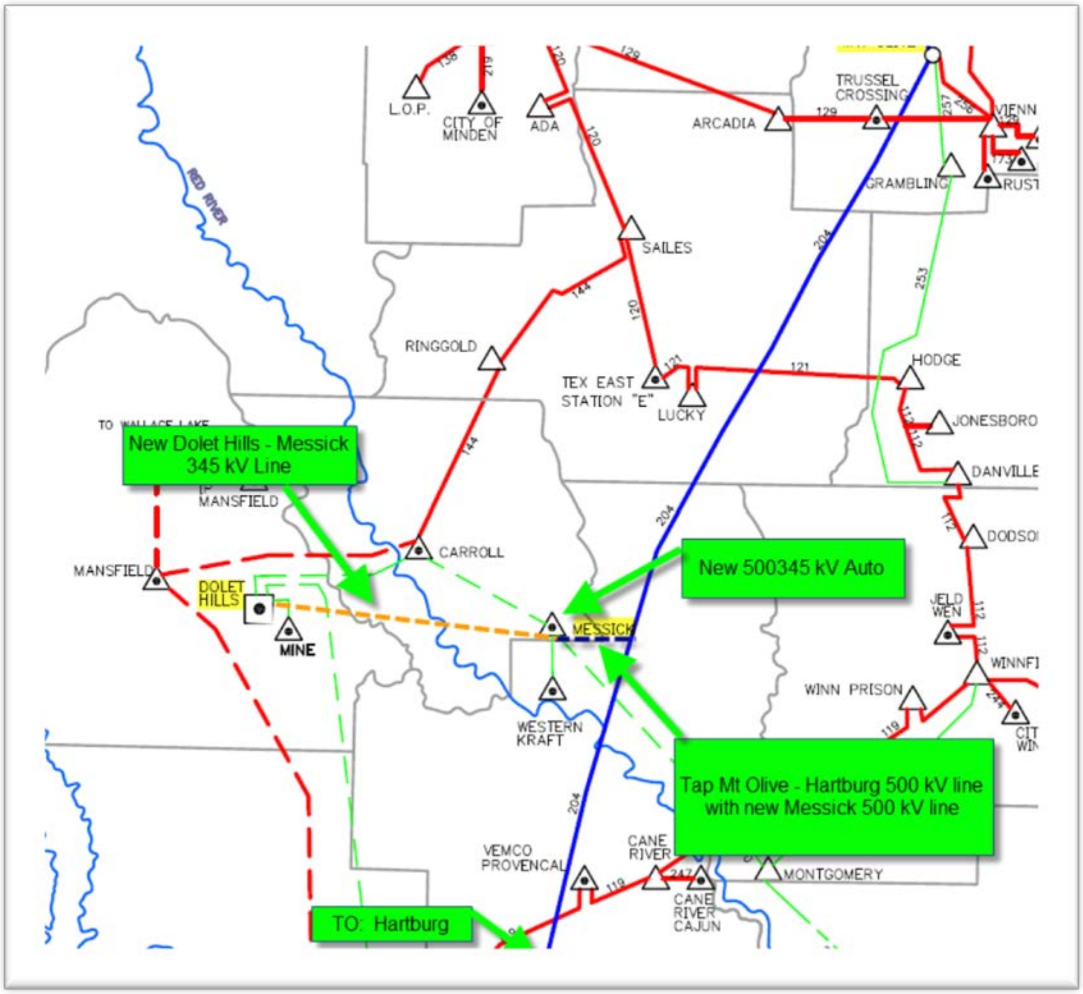


Figure 5.8: Proposed Messick 500/345kV Station and Messick – Dolet Hills 345kV Line

Description	Line Rating (MVA)	Upgrade Description	ICT Cost Estimate
New Messick 500/345 kV Auto	896	New 500/345 kV Auto at Messick	$11.2M
New Messick – Dolet Hills 345 kV Line	905	Construct a new 345kV transmission line from Messick to Dolet Hills (23 miles)	$97.9M
Tap Messick into Mt. Olive – Hartburg 500 kV line	1,200	Tap Messick into Mt. Olive – Hartburg 500 kV line (1.5 miles)	$6.3M
Total Cost:			**$115.4M**

Table 5.21: Dolet Hills to Messick Solution Set Upgrades

Economic Analysis

Subsequent to the powerflow analysis, an economic assessment was performed to determine the selected upgrades. The selected upgrades listed above have an estimated cost of $115.4 million.

- **Transmission Congestion**

  The following system congestion cost and flowgate loadings were monitored during the SCUC and SCED. The resulting congestion cost and congestion hours for 2018 are shown in Table 5.22 below for Entergy and the west to east interface transfers from Entergy to SPP.

	Base Case		Change Case			
			Change in Congestion Cost		Change in Congestion Hours	
Contingency	Congestion Cost ($K)	Congestion Hours	$K	%	Hours	%
East to West Transfer between Entergy and SPP	21,629	986	0	0	0	0
Entergy	636,848	27,011	(19,431)	(3.05)	(1314)	(4.86)

Table 5.22: 2018 Congestion Cost and Congestion Hours

- **Production Cost Results and Benefits**

  The project was applied to the GridView model and a full year simulation (8,760 hrs) was performed on the 2018 model to analyze the Entergy generation changes. The table below shows production cost changes for the Entergy units.

	Change in Adjusted Production Cost
Entergy	$7M

Table 5.23: 2018 Entergy Region Adjusted Production Cost Changes

- **LMP Levelization**

  ICT calculated the levelization of LMPs using output from GridView, which reported both load-weighted and generation-weighted LMP values for each hour of the year for the Entergy Louisiana region. ICT then calculated the standard deviation of the load-weighted and generation-weighted LMPs for each hour of the studied year. Using the largest 25% of all hours, the average load-weighted and generation-weighted standard deviations were calculated.

	Std. Dev. Δ ($)
New Messick auto and Messick to Dolet Hills Line	0.19

Table 5.24: Combined average Load-weighted and Generation-weighted Standard Deviation

5.5 Franklin – Bogalusa 500 kV Contingency

Engineering Analysis

This analysis focused on the contingency of the Franklin to Bogalusa 500 kV line. With the Franklin to Bogalusa 500 kV line out of service, north to south transfers are limited on the east side of the Entergy system due to the limits on the underlying 138 kV and 115 kV systems. After some initial review, no major overloads occurred. With the line out of service, a 1000 MW transfer from SPP South to Entergy was created which produced several issues. Possible solutions in the area included reconductoring Big Cajun to Addis 230 kV line, Dow Meter to Dow Cogen 230 kV line, and Hodges to Lucky to Texas East to Sailes 115 kV line. Also included with the solution was to upgrade Willow Glen 500/230 kV auto transformer. The above upgrades would increase the transfer capabilities.

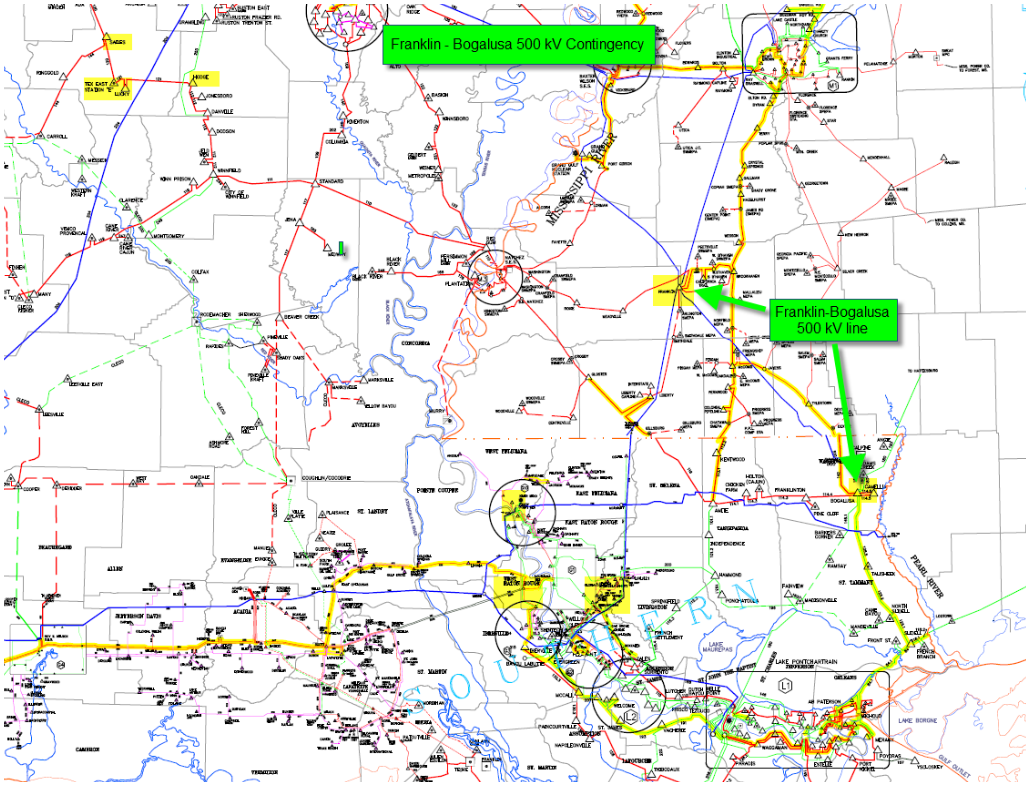


Figure 5.9: Franklin – Bogalusa 500 kV Contingency

Map Reference	Description	Non-Firm Curtailment (MWh)	Firm Curtailment (MWh)
1	Franklin – Bogalusa 500 kV Contingency	120	0

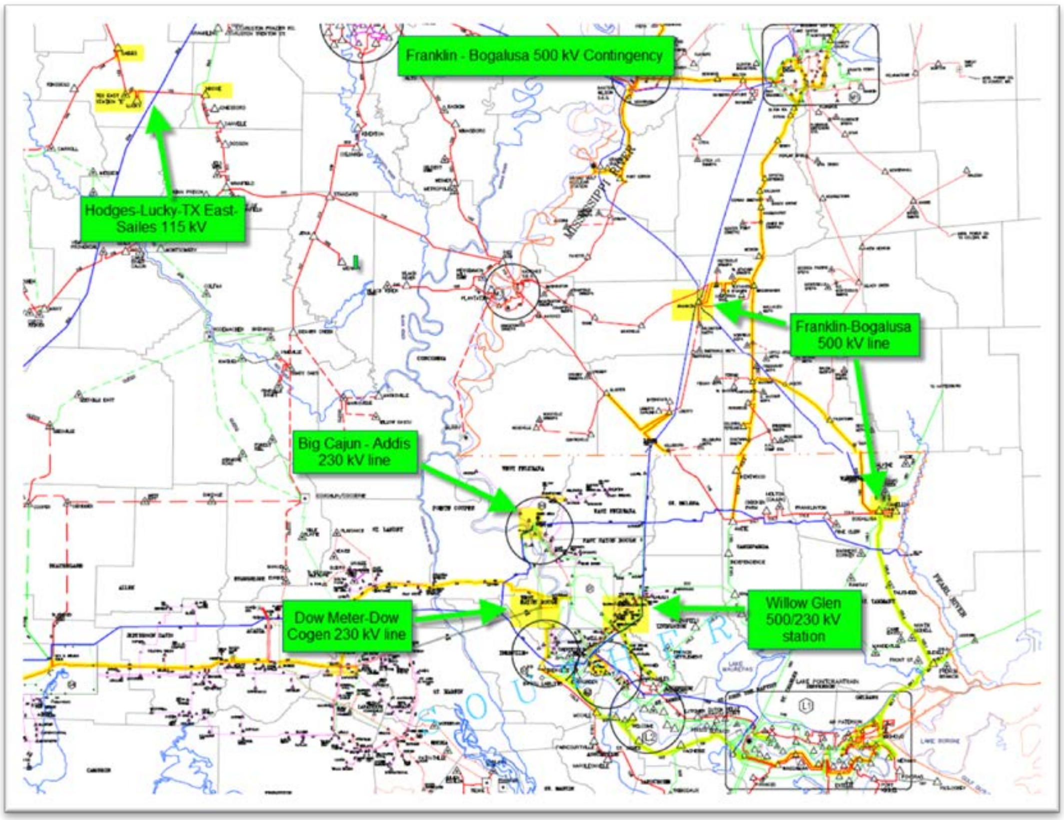
Table 5.25: 2011 Flowgate Curtailments

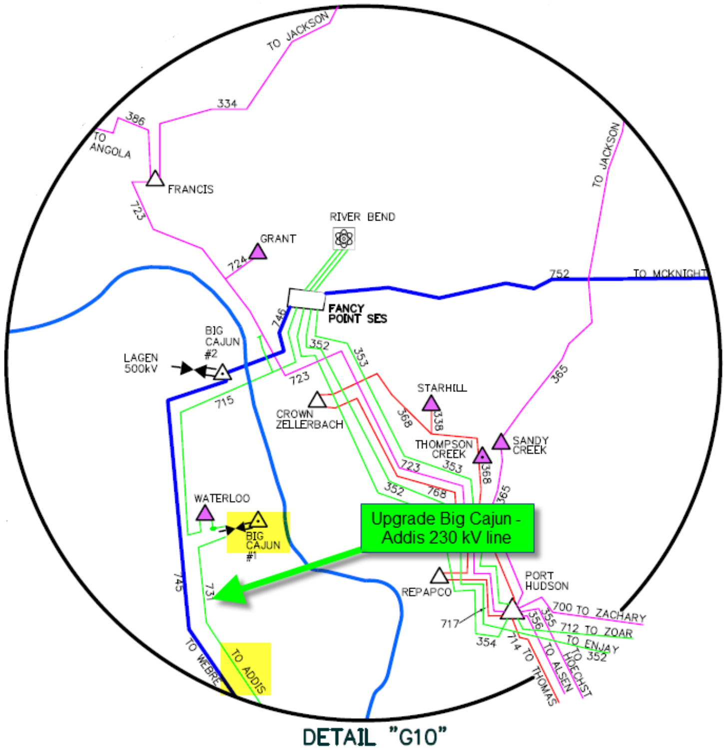
Map Reference	Description	Non-Firm* Events	Firm* Events
1	Franklin – Bogalusa 500 kV Contingency	275	0

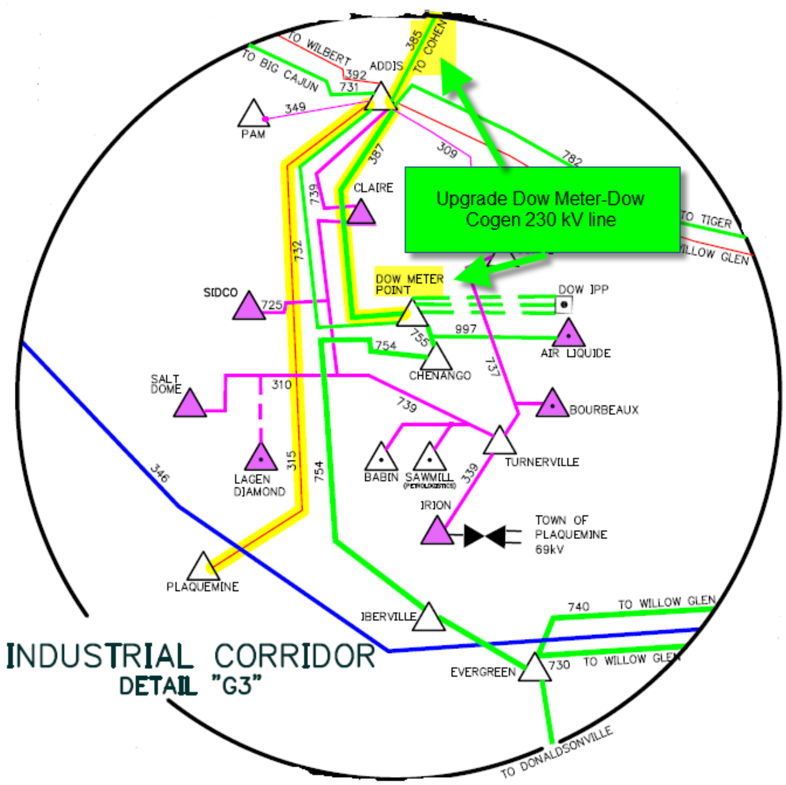
*Non-Firm and Firm Events are from 2011.

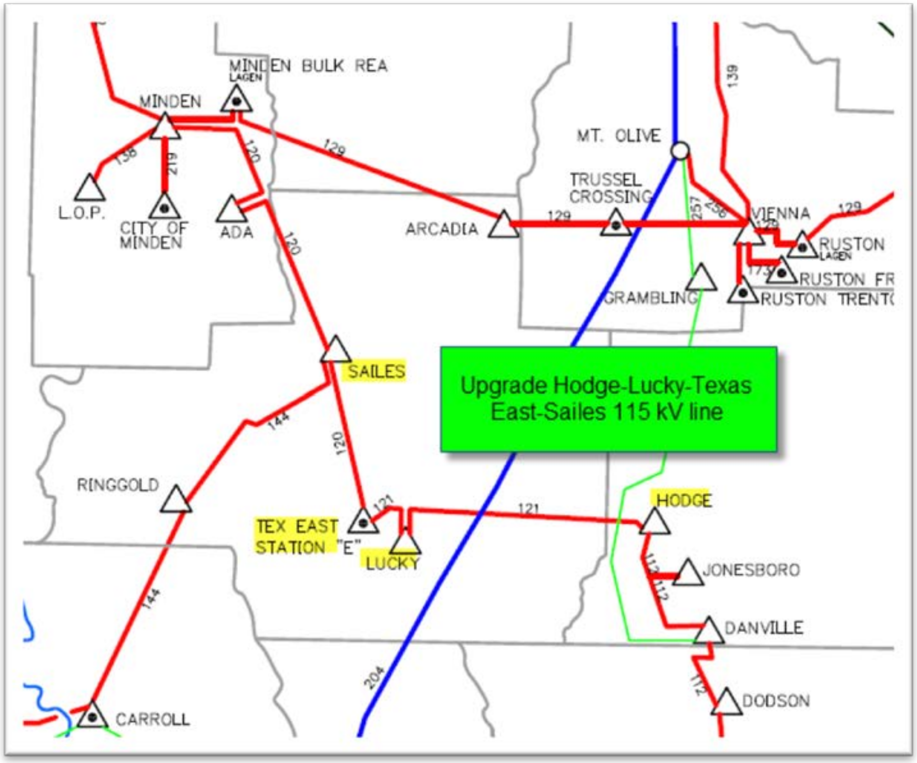
Table 5.26: 2011 Flowgate-limiting Events

The system conditions were evaluated under the Franklin to Bogalusa 500 kV contingency, focusing a north to south transfer on the network. With the Franklin to Bogalusa 500 kV line out of service, north to south transfers are limited on the east side of the Entergy system due to the limits on the underlying 138 kV and 115 kV systems. After some initial review, no major overloads occurred. With the Franklin to Bogalusa 500 kV line out of service, a 1,000 MW transfer was created which produced several issues in this region. Possible solutions in the area included reconductoring the Big Cajun to Addis 230 kV line, Dow Meter to Dow Cogen 230 kV line and Hodges to Lucky to Texas East to Sailes 115 kV line. Also included was an upgrade to the Willow Glen 500/230 kV auto transformer. Upgrades will increase the transfer capabilities in this area.




Upgrade Big Cajun - Addis 230 kV line
DETAIL "G10"


Upgrade Dow Meter-Dow Cogen 230 kV line
INDUSTRIAL CORRIDOR
DETAIL "G3"



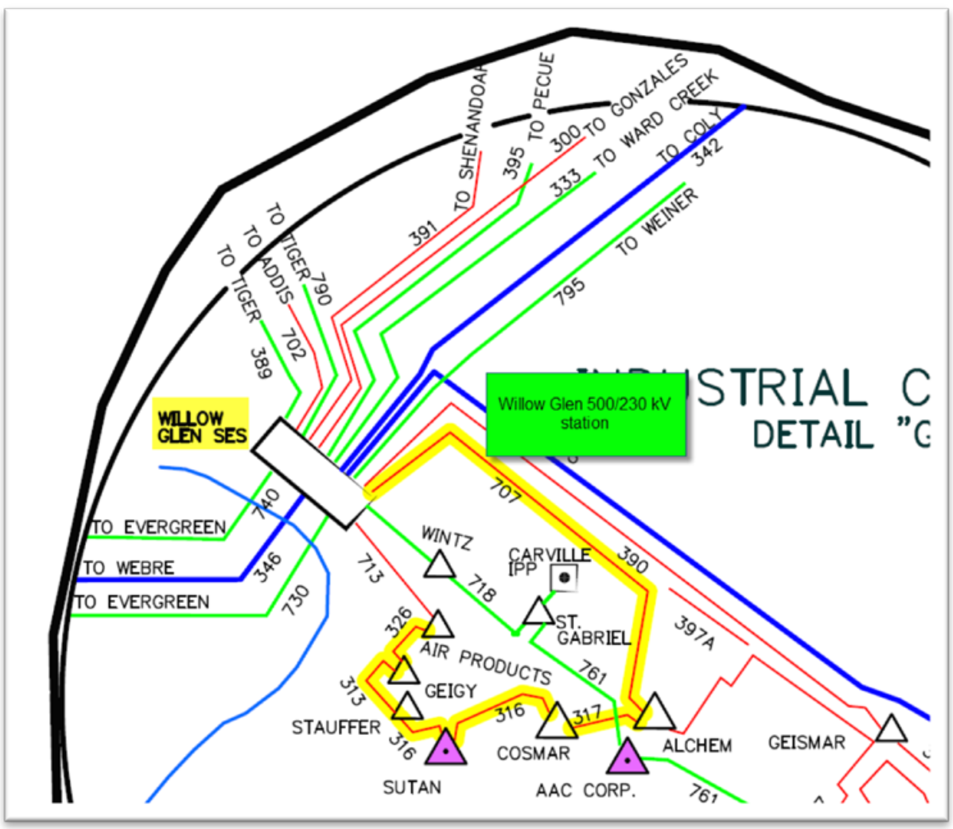


Figure 5.10: Proposed Franklin – Bogalusa 500 kV Solutions

Description	Line Rating (MVA)	Upgrade Description	ICT Cost Estimate
Big Cajun-Addis 230 kV Line	1039	Upgrade Big Cajun-Addis 230 kV Line (24.9 miles)	$34.5M
Dow Meter-Dow Cogen 230 kV line	900	Upgrade Dow Meter-Dow Cogen 230 kV line (2.16 miles)	$3M
Hodges-Lucky-Texas East-Sailes 115 kV line	291	Upgrade Hodges-Lucky-Texas East-Sailes 115 kV line (28.34 miles)	$28.4M
Willow Glen 500/230 kV Auto	672	Upgrade Willow Glen 500/230 kV Auto	$10.2M
		Total Cost:	**$76.1M**

Table 5.27: Franklin to Bogalusa 500 kV Solution Set Upgrades

Economic Analysis

Subsequent to the powerflow analysis, an economic assessment was performed to determine the selected upgrades. The selected upgrades listed above have an estimated cost of $76.1 million.

- **Transmission Congestion**

  The following system congestion cost and flowgate loadings were monitored during the SCUC and SCED. The resulting congestion cost and congestion hours for 2018 are shown in Table 5.28 below for Entergy and the Franklin – Bogalusa 500 kV contingency.

	Base Case		Change Case			
			Change in Congestion Cost		Change in Congestion Hours	
Contingency	Congestion Cost ($K)	Congestion Hours	$K	%	Hours	%
Franklin – Bogalusa 500 kV	167,468	4,831	(1,480)	(.88)	29	.60
EES	636,848	27,011	1284	.2	317	1.17

Table 5.28: 2018 Congestion Cost and Congestion Hours

- **Production Cost Results and Benefits**

  The project was applied to the GridView model and a full year simulation (8,760 hrs) was performed on the 2018 model to analyze the Entergy generation changes. The table below shows production cost saving for all of the Entergy units.

	Change in Adjusted Production Cost
Entergy	$5M

Table 5.29: 2018 Franklin - Bogalusa 500 kV Project Adjusted Production Cost

- ## LMP Levelization

ICT calculated the levelization of LMPs using output from GridView, which reported both load-weighted and generation-weighted LMP values for each hour of the year for the Entergy Louisiana region. ICT then calculated the standard deviation of the load-weighted and generation-weighted LMPs for each hour of the studied year. Using the largest 25% of all hours, the average load-weighted and generation-weighted standard deviations were calculated.

	Std. Dev. Δ ($)
Franklin – Bogalusa 500 kV	0.075

Table 5.30: Combined average Load-weighted and Generation-weighted Standard Deviation

Section 6: Summary

An event in the Available Flowgate Capability (AFC) occurs when a near-term request for non-firm or firm energy is refused or counteroffered due to a constrained flowgate. The total number of AFC events in 2011 for non-firm and firm service is in Table 6.1.

Under certain system conditions, flowgates can become constrained during real-time operations. When this occurs, the ICT will institute congestion management procedures, often in the form of Transmission Loading Relief (TLR). TLR procedures have a number of levels and can result in the curtailment of non-firm and/or firm transmission service. In addition to the operational issues, there are a number of flowgates that frequently constrain the sale of transmission service. The ISTEP 2012 includes upgrades that are intended to address some of the current most constraining flowgates from both a TLR and a transmission service perspective. The total 2011 firm and non-firm TLR Energy (MWh) curtailments for the ISTEP 2012 are listed below in Table 6.2.

	Non-Firm Events	Firm Events
New Hartburg-Sabine 230 kV Line	14,442	40,327
Dell-San Souci	44,771	52,364
Amite South	0	0
New 500/345 kV Station at Messick & Messick-Dolet Hills 345 kV Line	0	0
Franklin-Bogalusa Contingency	120	0

Table 6.1: AFC Events; January 2011-December 2011

	Non-Firm Curtailment (MWh)	Firm Curtailment (MWh)
New Hartburg-Sabine 230 kV Line	878	32,863
Dell-San Souci	0	0
Amite South	0	0
New 500/345 kV Station at Messick & Messick-Dolet Hills 345 kV Line	0	0
Franklin-Bogalusa Contingency	275	0

Table 6.2: TLR Curtailments; January 2011-December 2011

Powerflow and economic screening was performed on all five (5) projects selected for ISTEP 2012. The report shows all the projects provide some benefit to the system either by reducing congestion cost, improving LMP standard deviation, reducing AFC events, or reducing TLR curtailments.

Project	Upgrade Cost $M	Change in EES Congestion Cost		Change in EES Congestion Hours		Changes in EES Adjusted Production Cost $M
		$K	%	Hours	%	
New Hartburg-Sabine 230 kV Line	52.8	(15,409)	(2.42)	(177)	(.66)	13
Dell-San Souci	81.56	(3,562)	(.56)	(97)	(.36)	2
Amite South	51.1	264	.04	9	.033	0
New 500/345 kV Station at Messick & Messick-Dolet Hills 345 kV Line	541.5	(19,431)	(3.05)	(1,314)	(4.86)	7
Franklin-Bogalusa Contingency	76.1	(1,284)	(0.2)	(317)	(1.17)	5

Table 6.3: Project Summary

	APC-based Benefit-to-Cost Ratio
New Hartburg-Sabine 230 kV Line	1.41
Dell-San Souci	.14
Amite South	N/A
New 500/345 kV Station at Messick & Messick-Dolet Hills 345 kV Line	.07
Franklin-Bogalusa Contingency	.375

Table 6.4: Project Adjusted Production Cost

	Std. Dev. Δ ($)
New Hartburg-Sabine 230 kV Line	(0.27)
Dell-San Souci	(0.04)
Amite South	0.001
New 500/345 kV Station at Messick & Messick-Dolet Hills 345 kV Line	0.19
Franklin-Bogalusa Contingency	0.075

Table 6.5: Average Load-weighted and Generation-weighted Standard Deviation

The 2012 ISTEP study is a high-level engineering and economic assessment of specific upgrades which may have an economic benefit to users of Entergy's transmission system. Parties, including Entergy, that are interested in pursuing these projects further may want to undertake additional studies on their own to fine-tune the assumptions made by the ICT to their individual situations and to verify and determine what, if any, economic benefit would accrue to them. The ICT expects that a party wishing to proceed with construction of an upgrade would approach the ICT to engage in a joint process with Entergy to determine a more precise cost estimate and timeline for construction of the upgrades and to execute an agreement to do so.

Entergy has included the Orange County 230 kV Project (11-ETI-023-CP) in the 2013-2017 Construction Plan that will address the issue of the Hartburg to Cypress 500 kV contingency.

Appendix A: Approved Construction Plan Projects

Project Name	LE	Current Project In-Service Date
Holland Bottoms (Cabot EHV) Phase 2	EAI	Summer 2012
Ebony 161 kV Switching Station	EAI	Summer 2012
W Benton North-Benton South	EAI	Winter 2012
Pine Bluff Voltage Support Poyen Cap Bank	EAI	Summer 2012
Sheridan South 500 kV Flowgate Mabelvale 500 kV Substation	EAI	Summer 2014
Sheridan South 500 kV Flowgate Sheridan 500 kV Substation	EAI	Summer 2014
Sheridan South 500 kV Flowgate White Bluff 500 kV Substation	EAI	Summer 2014
Sheridan South 500 kV Flowgate Eldorado 500 kV Substation	EAI	Summer 2014
Ebony 161 kV Switching Station Capacitor Bank	EAI	Summer 2012
Basin Springs - Construct New Substation	EAI	Summer 2013
Construct new Nelson to Moss Bluff 230kV line	EGSL	Summer 2012
Acadiana Area Improvement Project - Phase 2 Part 2 of 2	EGSL	Summer 2012
Fireco to Copol 69 kV line Upgrade switches & line traps	EGSL	Summer 2012
Addis 69 kV Upgrade switches and line traps	EGSL	Summer 2012
Jackson to Tejac 69kV - Upgrade Line Rev1	EGSL	Summer 2012
Francis 69kV - Add Cap Bank	EGSL	Summer 2013
Fireco to Copol 69 kV line Upgrade line conductor Rev1	EGSL	Winter 2012
Acadia Generation Reconfigure Richard 138 kV Rev3	EGSL	Summer 2013
Acadia Generation Upgrade Moril to Hopkins 138kV line	EGSL	Summer 2013
Acadia Generation Upgrade Scott 69 kV breaker 18220	EGSL	Summer 2012
Lake Charles Bulk Sub - Replace Switches Rev0	EGSL	Summer 2012
Willow Glen to Conway - Construct new 230kV Line Rev1	EGSL	Winter 2013
Acadiana Area Improvement Project - Phase 2 Part 1 of 2 - REV1	EGSL	Summer 2012
SELA Coast Improve Ph 2 Rev 1	ELL	Fall 2012
SELA Coast Improve Ph 3 Rev 1	ELL	Winter 2012
Ironman to Tezcuco 230 kV line Rev 1	ELL	Summer 2018
Rebuild Golden Meadow to Leevile	ELL	Winter 2013
NE Louisiana Improvement Project - Phase 1 r4	ELL	Winter 2012
NE Louisiana Improvement Project - Phase 2 r9	ELL	Summer 2014
NM6 Ninemile Switch yard Interconnection	ELL	Winter2014
NM6 Upgrade Michoud Breaker	ELL	Winter2014
Upgrade Ninemile to Southport Ckt 1	ELL	Winter2014
11-ELL-010-2 2014W Upgrade Ninemile to Southport Ckt 2 rev1	ELL	Winter2014
Ridgeland-Madison Reliability Improvement rev1	EMI	Summer 2012
Ridgeland-Madison Reliability Improvement rev1	EMI	Summer 2012

Project Name	LE	Current Project In-Service Date
Ouachita Project - Baxter Wilson Auto	EMI	Summer 2012
Grenada-Winona-Greenwood Area Improvement Phase II (line)	EMI	Summer 2012
Grenada-Winona-Greenwood Area Improvement Phase II (auto)	EMI	Summer 2012
Ray Braswell - Wyndale 115kV New Line r3	EMI	Summer 2013
Church Rd-Getwell 230kV line	EMI	Summer 2013
Ray Braswell to West Jackson Reconductor	EMI	Summer 2012
ERCOT Emergency Load (College Station)	ETI	Fall 2012
Add Somerville 69kV Cap Bank	ETI	Summer 2012

Appendix B: Fuel Price Forecasts

Gas Price Forecast Summary

Year	Month	Louisiana		Mississippi		Arkansas		Texas East	
		No LDC	With LDC	No LDC	With LDC	No LDC	With LDC	No LDC	With LDC
2018	1	$6.82	$6.90	$6.82	$6.98	$7.23	$7.44	$6.59	$6.62
	2	$6.78	$6.86	$6.77	$6.94	$7.19	$7.40	$6.55	$6.58
	3	$6.59	$6.67	$6.59	$6.76	$6.99	$7.20	$6.37	$6.39
	4	$6.17	$6.25	$6.16	$6.32	$6.54	$6.75	$6.04	$6.07
	5	$6.12	$6.20	$6.11	$6.27	$6.49	$6.70	$5.99	$6.02
	6	$6.17	$6.25	$6.16	$6.32	$6.54	$6.75	$6.04	$6.07
	7	$6.23	$6.31	$6.22	$6.39	$6.61	$6.82	$6.11	$6.13
	8	$6.28	$6.36	$6.27	$6.43	$6.66	$6.87	$6.15	$6.18
	9	$6.29	$6.37	$6.28	$6.45	$6.67	$6.88	$6.17	$6.19
	10	$6.36	$6.44	$6.35	$6.52	$6.74	$6.95	$6.24	$6.26
	11	$6.58	$6.65	$6.57	$6.73	$6.97	$7.18	$6.35	$6.38
	12	$6.80	$6.88	$6.80	$6.96	$7.21	$7.42	$6.58	$6.61

Oil Price Forecast Summary

Year	Month	Louisiana		Mississippi		Arkansas		Texas East	
		FO2	FO6	FO2	FO6	FO2	FO6	FO2	FO6
2018	1	$22.54	$12.45	$22.87	$9.21	$22.54	$12.45	$22.54	$12.45
	2	$22.53	$12.46	$22.87	$9.21	$22.53	$12.46	$22.53	$12.46
	3	$21.55	$12.46	$21.87	$9.22	$21.55	$12.46	$21.55	$12.46
	4	$21.43	$12.47	$21.75	$9.22	$21.43	$12.47	$21.43	$12.47
	5	$20.46	$12.47	$20.77	$9.22	$20.46	$12.47	$20.46	$12.47
	6	$20.22	$12.48	$20.52	$9.23	$20.22	$12.48	$20.22	$12.48
	7	$20.27	$12.48	$20.57	$9.23	$20.27	$12.48	$20.27	$12.48
	8	$20.62	$12.49	$20.93	$9.24	$20.62	$12.49	$20.62	$12.49
	9	$21.19	$12.50	$21.51	$9.24	$21.19	$12.50	$21.19	$12.50
	10	$21.45	$12.50	$21.77	$9.25	$21.45	$12.50	$21.45	$12.50
	11	$21.68	$12.51	$22.00	$9.25	$21.68	$12.51	$21.68	$12.51
	12	$22.01	$12.51	$22.34	$9.25	$22.01	$12.51	$22.01	$12.51

Coal Price Forecast Summary

Complex	Capacity	State	2018
Flint Creek	528	AR	2.16
White Bluff 1 & 2	1,640	AR	2.66
Independence 1 & 2	1,678	AR	2.67
Nearman Creek	200	KS	1.96
Holcomb	362	KS	1.93
Lawrence EC 5	373	KS	2.06
Lacygne 2	682	KS	1.69
Jeffery EC 1 - 3	2,164	KS	1.8
Roy L. Nelson 6	550	LA	2.55
Dolet Hills	650	LA	2.04
Rodemacher 2	512	LA	2.75
Rodemacher 3	660	LA	2.75
Sikeston	235	MO	2.03
Montrose 1 - 3	505	MO	1.69
Hawthorn 5	545	MO	1.7
Iatan 1 & 2	1,556	MO	1.94
Sheldon 1 & 2	225	NE	1.44
North Omaha 2 -5	478	NE	1.44
Gentleman 1 & 2	1,295	NE	1.26
Nebraska City 1 & 2	1,316	NE	1.47
AES Shady Point 1 & 2	320	OK	1.85
Hugo	440	OK	2.03
GRDA 1	490	OK	2.26
GRDA 2	520	OK	2.26
Sooner 1 & 2	1,046	OK	2.43
Muskogee 4 - 6	1,496	OK	2.25
Pirkey	675	TX	2.04
Harrington 1 - 3	1,021	TX	2.19
Tolk 1 & 2	1,060	TX	2.02
Welsh 1 - 3	1,584	TX	2.42
Plum Point 1	735	AR	2.67
Missouri		MO	1.84
Louisiana		LA	2.71
Arkansas		AR	2.5
Tennessee		TN	2.71
Alabama		AL	2.71
Kentucky		KY	2.71
Mississippi		MS	2.71
Texas		TX	2.17
Oklahoma		OK	2.18

Complex	Capacity	State	2018
Georgia		GA	2.71
Florida		FL	2.71
Kansas		KS	1.89
Southwest			2.10
Nebraska		NE	1.4